bryant

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Payne

installation, operation, and maintenance instructions

PACKAGED HEAT PUMPS

542E

Sizes 024 thru 060

& 542D060

Cancels: 40542DP6-A 40542DP16-A

6/1/80

NOTE TO INSTALLER: Leave these instructions with the unit after installation.

NOTE: The installation of this unit must conform to the guidelines presented in these unit Installation Instructions. Read and become familiar with this publication before starting installation.

INTRODUCTION

Models 542D and 542E Packaged Heat Pumps are fully self-contained combination heating/cooling units designed for outdoor installation. Model 542E may be installed either on a rooftop or ground-level slab. See Figure 1. Model 542D is used with an accessory roof-mounting curb (P/N 304851-302) and incorporates a down-discharge/return-air plenum as an integral part of the unit. See Figure 2.

These units are factory-charged with R-22 refrigerant. Installation is simple: connect condensate drain, air ducts, high- and low-voltage wiring, and install a field-supplied air filter (except for model 542D which has factory-supplied air filters).

All units can be connected into existing duct systems *that are properly sized and designed to handle an airflow of 350 to 450 ft³/min per each 12,000 Btuh of rated unit capacity. See Table I for indoor airflow requirements.*

Accessory UL-listed, field-installed, supplemental electric heat packages are available in a variety of KW and voltage options. These electric resistance heaters mount inside the unit blower compartment.

A full line of rooftop system accessories is available for field installation. These accessories include plenums with factory-supplied air filters (plenum not required with Model 542D), roof-mounting curbs, horizontal and downflow economizers, barometric relief dampers, concentric diffuser boxes, and flexible duct packages. Filter racks with air filters are available for rooftop or ground-level installation.

NOTE: When installing any accessory item, see the Installation Instructions packaged with the accessory.

IMPORTANT—READ BEFORE INSTALLING

1. This installation must conform with all applicable local and national codes.
2. The power supply (volts, hertz, and phase) must correspond to that specified on unit rating plate.
3. The electrical supply provided by your utility must be sufficient to handle the load imposed by this unit.
4. Refer to the 542D or 542E dimensional drawing for locations of electrical inlets, condensate drain, duct connections, and required clearances before setting unit in place.
5. Styrofoam shipping blocks located between compressor and divider panel and between accumulator and divider panel must be removed. A failure to remove these blocks can result in undesirable vibration noises being transmitted into the conditioned space.

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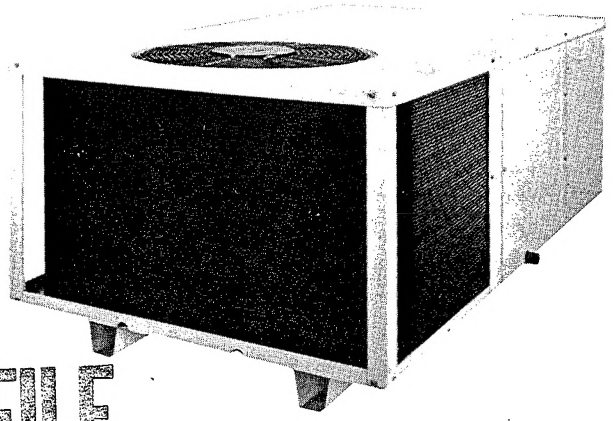

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Figure 1—Model 542E

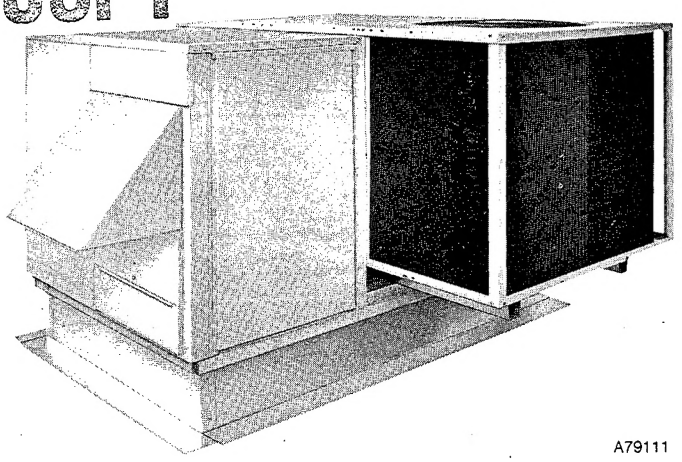

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Figure 2—Model 542D060 Mounted on Accessory Roof-Mounting Curb

GENERAL

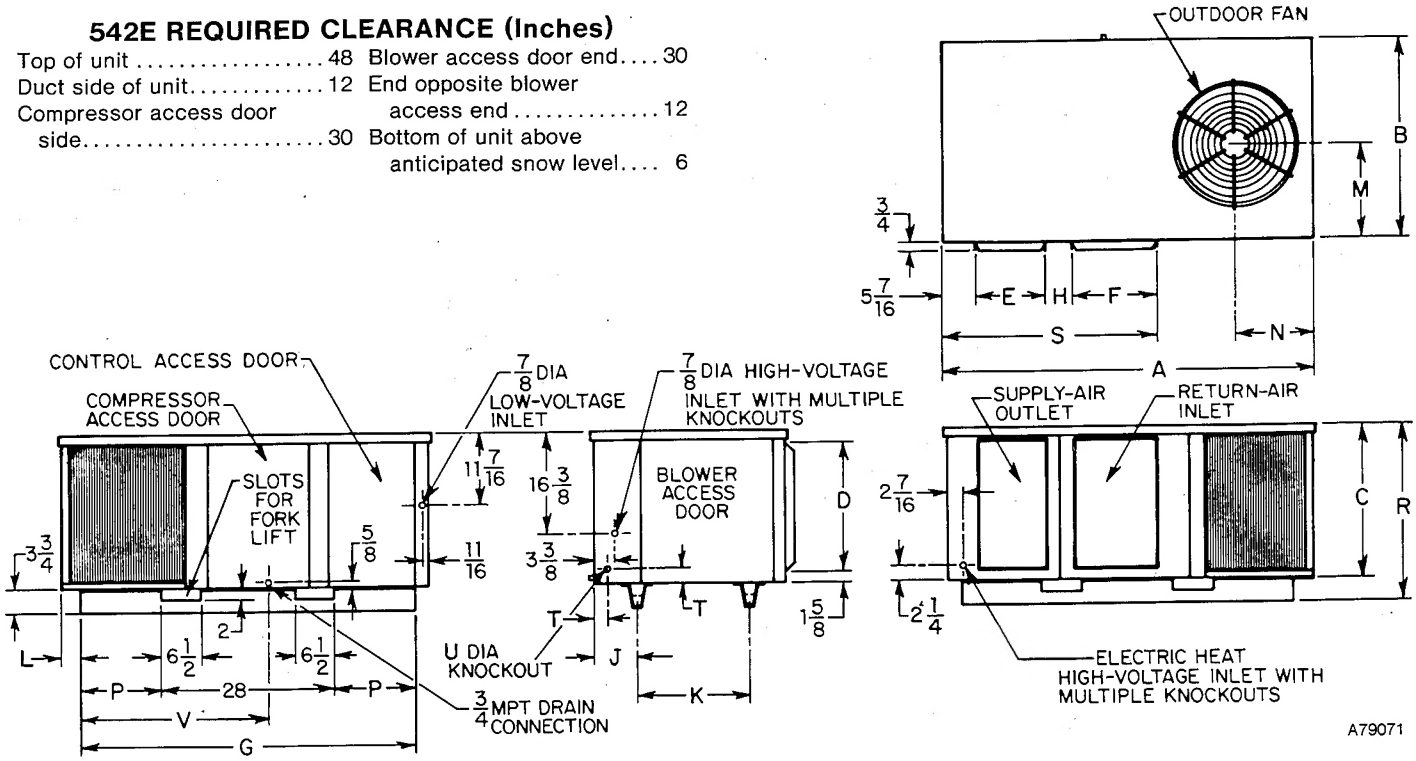
Models 542D and 542E Packaged Heat Pumps have been designed and tested in accordance with ARI Standards 240-77 and 270-75, and these units are UL-listed.

This publication contains the following sections:

I. Moving and Setting Unit in Place
II. Condensate and Defrost Disposal
III. Duct Connections
IV. Electrical Connections
V. Preparing Unit for Startup
VI. Startup and Adjustments
VII. Sequence of Operation
VIII. Care and Maintenance

542E REQUIRED CLEARANCE (Inches)

Top of unit	48	Blower access door end	30
Duct side of unit	12	End opposite blower access end	12
Compressor access door side	30	Bottom of unit above anticipated snow level	6



542E DIMENSIONS (Inches)

Size	A	B	C	D	E	F	G	H	J
024 & 030	60-3/16	32-3/16	24-13/16	21	11-1/2	13-5/16	57	6-7/8	6-15/16
036	60-3/16	32-3/16	24-13/16	21	13-3/4	13-5/16	57	4-5/8	6-15/16
042, 048, & 060	68-3/16	40-3/16	30-13/16	21	16-3/8	17-5/16	65	5-1/8	7-1/2

Sizes	K	L	M	N	P	R	S	T	U	V
024 & 030	18-1/8	1-1/2	15-3/32	12-9/16	14-1/2	28-9/16	37-1/8	2	7/8	27-7/8
036	18-1/8	1-1/2	15-3/32	12-9/16	14-1/2	28-9/16	37-1/8	2	7/8	27-7/8
042, 048, & 060	25	1-1/2	20-3/32	15-1/8	18-1/2	34-9/16	44-1/4	2	7/8	35-3/16

Figure 3—542E Dimensional Drawing

TABLE I—RATINGS, PERFORMANCE, & RECOMMENDED FILTER SIZES

MODEL	542E						542D
SIZE	024	030	036	042	048	060	060
SERIES	A	A	A	A	A	A	A
Rated Heating Capacity @ 47°F (Btuh)*	26,000	30,000	35,000	42,000	48,000	58,000	58,000††
Total Power Consumption (Watts)*	2850	3450	3850	4600	5100	6300	6300††
COP*	2.7	2.5	2.7	2.7	2.8	2.7	2.7††
Rated Heating Capacity @ 17°F (Btuh)*	13,500	16,000	18,000	21,000	25,000	31,000	31,000††
Total Power Consumption (Watts)*	2350	2900	3000	3700	4150	5300	5300††
COP*	1.7	1.6	1.8	1.7	1.8	1.7	1.7††
Rated Cooling Capacity @ 95°F (Btuh)*	25,500	30,000	35,000	41,000	47,000	57,000	57,000††
Total Power Consumption (Watts)*	3350	3900	4650	5150	6100	7600	7600††
EER	7.6	7.7	7.5	8.0	7.7	7.5	7.5††
Rated Indoor Airflow (Ft^3/Min)*	850	1050	1300	1535	1700	2000	2000††
Rated External Static Pressure (In. wc)*	0.10	0.15	0.15	0.15	0.20	0.20	0.20††
ARI Sound Rating Number†	19	19	19	18	18	20	20
Recommended Minimum Filter Size (Sq In.)‡							
Standard-Type	408	504	624	737	816	960	**
Cleanable- or High-Capacity-Type	265	328	406	479	530	624	**

*Rated in accordance with ARI Standard 240-77.
†Rated in accordance with ARI Standard 270-75.
‡Recommended field-supplied filter sizes shown are based on a velocity of 300 ft/min at the rated indoor airflow.
**Two 20 x 20 x 1 air filters are furnished with Model 542D060.
††To achieve the performance ratings indicated, the fresh-air and exhaust openings of the plenum section must be sealed airtight, the fresh-air damper must be insulated, and the plenum section must be supported by a curb around an opening to the indoor airspace.

542D060 REQUIRED CLEARANCES (Inches)

Top of unit	48	Blower access door end	30
Compressor access door side	30	End opposite blower access end	12
Side opposite compressor access door	12	Bottom of unit above anticipated snow level	6

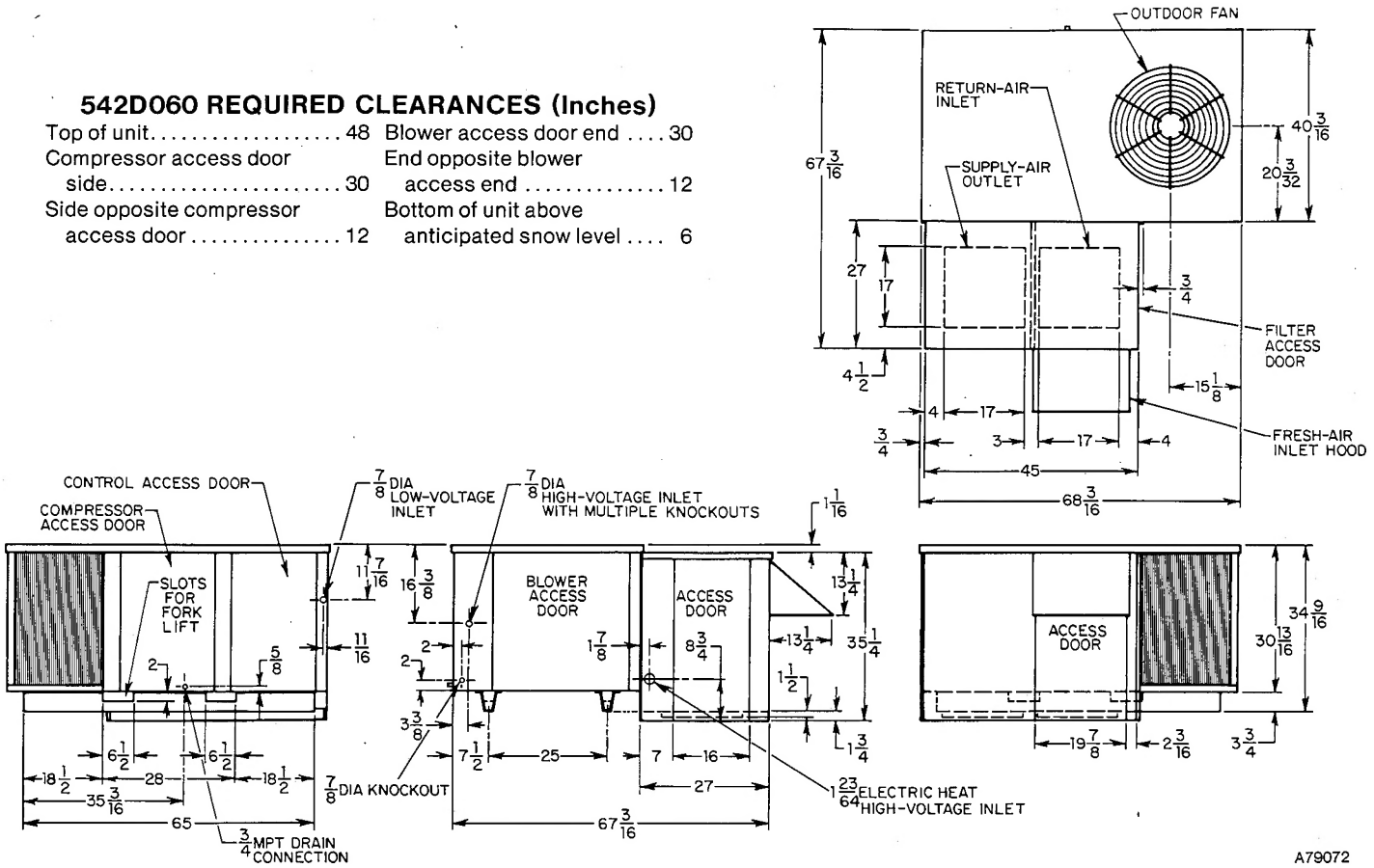


Figure 4—542D060 Dimensional Drawing

TABLE II—ELECTRICAL DATA—MODEL 542E—SIZES 024 THRU 042

MODEL	542E					
SIZE	J024	J030	J036	P036	B042	P042
SERIES	A	A	A		A	
Unit Volts—Phase (60Hz)	208-230—1	208-230—1	208-230—1	208/230—3	230—1	208/230—3
Operating Voltage Range	197—253	197—253	197—253	187—253	207—253	187—253
Total Unit Amps	16.7	22.7	23.9	14.8	28.7	21.0
Max Branch Circuit Fuse Size (Amps)	30	45	45	25	50	40
Unit Ampacity for Wire Sizing	20.2	27.5	29.2	17.8	34.9	25.2
Minimum Wire Size (AWG)*	10	10	10	12	8	10
Maximum Wire Length (Ft)*	115	85	80	95	112	107

TABLE III—ELECTRICAL DATA—MODELS 542E048, 542D060, & 542E060

MODEL	542E			542E	542D & 542E	
SIZE	B048	P048	E048	060	P060	E060
SERIES	A			A	A	
Unit Volts—Phase (60Hz)	230—1	208/230—3	460—3	230—1	208/230—3	460—3
Operating Voltage Range	207—253	187—253	414—506	207—253	187—253	414—506
Total Unit Amps	31.9	22.4	10.9	40.9	30.1	13.7
Max Branch Circuit Fuse Size (Amps)	60	45	20	60	50	25
Unit Ampacity for Wire Sizing	38.9	27.1	13.2	49.8	35.6	15.7
Minimum Wire Size (AWG)*	8	10	14	6	8	12
Maximum Wire Length (Ft)*	101	100	181	123	119	229

*Use only copper wire for field connections to unit. Wire size is based on 60 or 75°C copper conductor at 86°F (30°C) ambient temperature and ampacity shown in table. If other than 60 or 75°C copper conductor is used, if ambient temperature is above 86°F, or if voltage drop of wire exceeds 2% of unit rated voltage, determine wire size from ampacity shown and the National Electrical Code. Wire lengths shown are measured one way along the wire path between unit and service panel for minimum voltage drop.

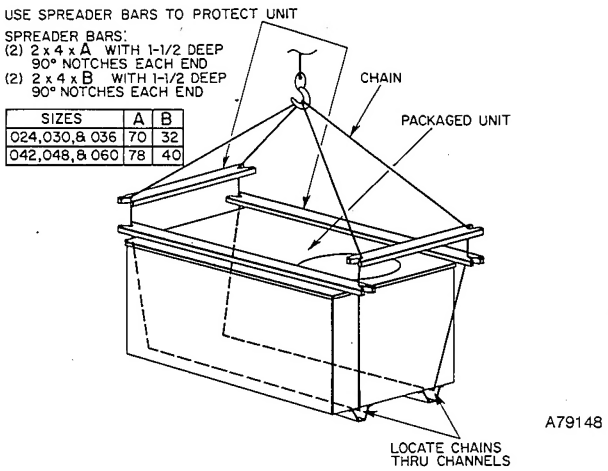


Figure 5—542E Suggested Rigging

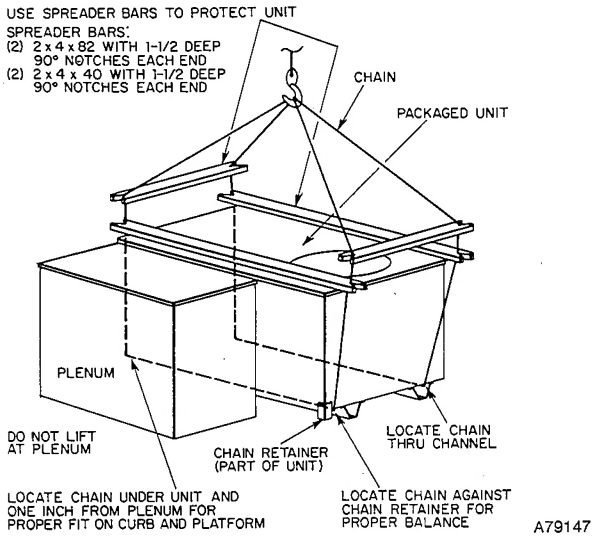


Figure 6—542D060 Suggested Rigging

I. MOVING AND SETTING UNIT IN PLACE

CAUTION: Use spreader bars when rigging the unit to be lifted to protect the top and sides. Model 542E must be rigged for lifting as shown in Figure 5. Model 542D must be rigged for lifting as shown in Figure 6. Use extreme caution to prevent damage when moving the unit. It must remain in an upright position during all rigging and moving operations. The unit must be level for proper condensate drainage; therefore, the ground-level pad or accessory roof-mounting curb must be level before setting the unit in place. When a field-fabricated support is used instead of the accessory curb, ensure that the support is level and properly supports the unit and plenum.

When selecting an installation site, locate the unit on the side opposite the prevailing wind to assure proper operation of the defrost cycle and to avoid snow drifts that could block the outdoor coil. *Be sure that the unit is installed at least 6 inches above the highest probable snow level to prevent blockage of the outdoor coil and to assure proper drainage of defrosted ice.*

A. Rooftop Installation

CAUTION: When installing the unit on a rooftop, be sure that the roof will support the additional weight. Refer to the Product Data Sheet (PDS) for Models 542D and 542E to obtain total weight and corner weight information.

When installing a Model 542D Downflow Unit or a Model 542E End-discharge Unit with an accessory downflow plenum, the accessory roof-mounting curb must be installed on, and flashed into, the roof before unit installation. The instructions for installing the curb are packaged with the curb.

When installing a Model 542E *without* downflow plenum, place the unit on a level base that provides proper support. On flat roofs, be sure that the unit is located at least 4 inches above the highest expected water level on the roof to prevent flooding. Consult local codes for additional installation requirements.

B. Ground-Level Installation

Place the unit on a solid, level concrete pad that is a minimum of 4 inches thick and that extends approximately 2 inches beyond the casing on all four sides of the unit. Do not secure the unit to the pad *except* when required by local codes.

C. Clearances

The required minimum operating and service clearances are shown in Figures 3 and 4. (Refer to the 542D clearances when installing Model 542E with an accessory downflow plenum.)

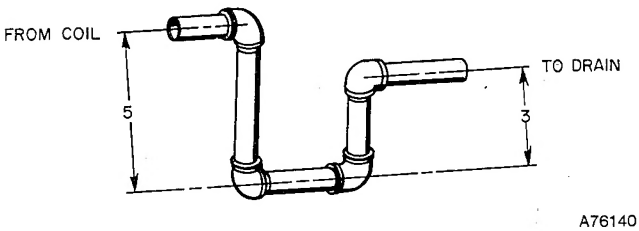


Figure 7—Condensate Drain Trap

CAUTION: Do not restrict outdoor airflow. An air restriction at either the outdoor-air inlet (the entire surface of the outdoor coil) or the fan discharge can be detrimental to compressor life.

The outdoor fan discharges through the top of the unit. Ensure that the fan discharge does not recirculate to the outdoor coil. Do not locate the unit in either a corner or under a complete overhead obstruction. The minimum clearance under a partial overhang (such as a normal house roof overhang) is 48 inches.

Do not locate the unit where water, ice, or snow from an overhang or roof will damage or flood the unit by falling on the top. Do not locate the unit where grass, shrubs, or other plants will interfere with the airflow either into or out of the unit.

II. CONDENSATE AND DEFROST DISPOSAL

NOTE: Ensure that defrost and condensate water disposal methods comply with local codes, restrictions, and practices.

Models 542D and 542E dispose of condensate water through a 3/4-inch MPT plastic drain fitting. To prevent damage during the shipping and moving of the unit, this fitting and a plastic drain pipe are shipped inside the unit compressor compartment (secured with tape). Locate this fitting and insert the nonthreaded end into the plastic drain pipe. See Figure 8. Insert the plastic pipe over the drain on the drain pan. The pipe and fitting must lay flat against the base for proper drainage. The residual curvature in the pipe must be in a horizontal plane.

Install a 3-inch trap at the drain fitting to ensure proper drainage. See Figure 7. Make sure that the outlet of the trap is at least 2 inches lower than the unit drain pan connection to prevent the pan from overflowing. Prime the trap with water.

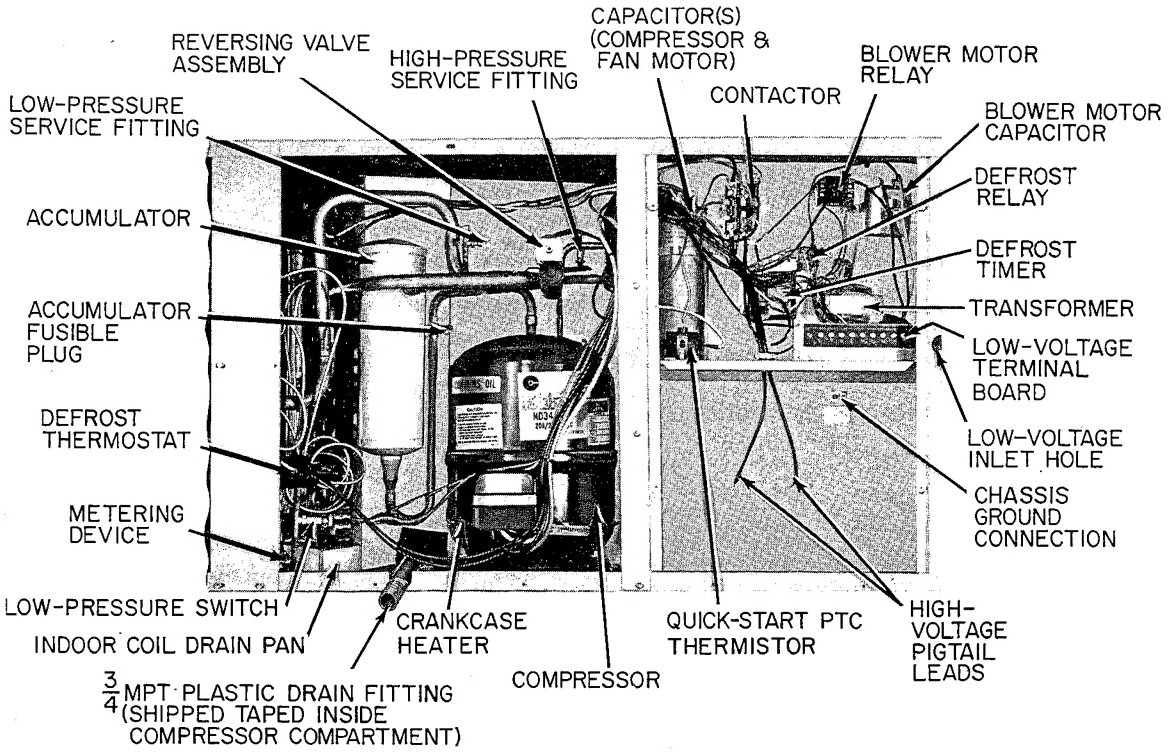


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Figure 8—Partial Side View With Compressor & Control Access Panels Removed (Model 542E036, 208V-230V—1)

During the heating defrost cycle, defrost water from the melting ice on the outdoor coil flows through the holes in the heat pump base directly below the outdoor coil. When using a field-supplied drain pan to catch the defrost water, be sure that this pan is at least 2 inches high and extends at least 2 inches beyond the width and length of the unit.

If the installation requires draining the condensate and/or defrost water away from the unit, connect a drain tube(s), using a minimum of 7/8-inch OD copper tubing, 3/4-inch galvanized pipe, or 7/8-inch plastic pipe. *Do not undersize the tube(s).* Pitch the drain tube(s) downward at a slope of at least 1 inch in every 10 feet of horizontal run. Be sure to check the drain tube(s) for leaks.

Condensate and defrost water can be drained directly onto the roof in rooftop installations (where permitted) or onto a gravel apron in ground-level installations. When using a gravel apron, make sure it slopes away from the unit.

III. DUCT CONNECTIONS

Model 542E has duct flanges on the supply- and return-air openings on the side of the unit. See Figure 3 for connection sizes and locations.

Model 542D has duct flanges on the supply- and return-air openings on the bottom of the unit. See Figure 4 for connection sizes and locations.

WARNING: The design and installation of the duct system must be in accordance with the standards of the National Fire Protection Association for installation of nonresidence-type air conditioning and ventilating systems, NFPA No. 90; or residence-type, NFPA No. 90B; and/or local codes and ordinances.

Adhere to the following criteria when selecting, sizing, and installing the duct system:

1. Select and size ductwork, supply-air registers, and return-air grilles according to ASHRAE recommendations and as presented in BDP training materials.

CAUTION: When the duct system fastening holes are being drilled into the side of Model 542E instead of the unit duct flanges, use extreme care to avoid puncturing the coil or coil tubes.

2. Use a flexible transition between rigid ductwork and unit to prevent transmission of vibration. The transition may be screwed or bolted to duct flanges. Use suitable gaskets to ensure a weather and airtight seal.

NOTE: When using a supplemental electric heater, maintain a minimum clearance of one inch to combustible materials for the first 36 inches of duct and use fireproof material for the transition between the ductwork and unit supply-air duct flange. When using flexible duct (which is not heat resistant), use a 36-inch long sheet metal duct between the supply outlet and the flexible duct. Observe the warning on the unit rating plate.

3. Install an external, field-supplied air filter(s) in the return-air ductwork where it is easily accessible for service. Recommended filter sizes are shown in Table I. (Model 542D has factory-supplied air filters.)
4. Size all ductwork for required indoor airflow of heat pump being installed. This airflow will be adequate for safe electric heater operation (except when using 20-KW heater with 030-size unit airflow must be at least 1000 ft^3/min). Avoid abrupt duct size increases or decreases.
5. Adequately insulate and weatherproof all ductwork located outdoors. Insulate ducts passing thru an unconditioned space, and use a vapor barrier in accordance with the latest issue of SMACNA and NESCA minimum installation standards for heating and air conditioning systems. Secure all ducts to the building structure.
6. Flash, weatherproof, and vibration-isolate all openings in building structure in accordance with local codes and good building practices.

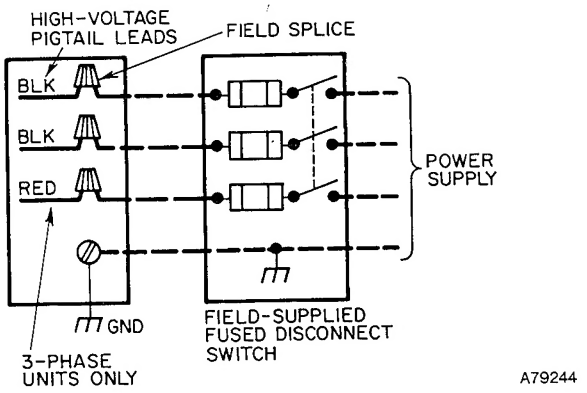


Figure 9—Field High-Voltage Connections

IV. ELECTRICAL CONNECTIONS

WARNING: The unit cabinet must have an uninterrupted, unbroken, electrical ground to minimize the possibility of personal injury if an electrical fault should occur. This ground may consist of electrical wire connected to the unit ground lug in the control compartment, or conduit approved for electrical ground when installed in accordance with the National Electrical Code and local electrical codes. A failure to follow this warning could result in the installer being liable for the personal injury of others.

CAUTION: A failure to follow these precautions could result in damage to the unit being installed:

1. Make all electrical connections in accordance with the National Electrical Code and local electrical codes governing such wiring.
2. Use only *copper* conductor for connections between the field-supplied electrical disconnect switch and the unit. DO NOT USE ALUMINUM WIRE.
3. Ensure that high-voltage power to the unit is within the operating voltage range indicated on the unit rating plate. On 3-phase units, ensure that phases are balanced within 2%. Consult the local power company for correction of improper voltage and/or phase balance.
4. Insulate low-voltage wires for the highest voltage contained within the conduit when low-voltage control wires are run in the same conduit as high-voltage wires.
5. Do not damage internal components when drilling thru any panel to mount electrical hardware, conduit, etc.
6. Make sure that the service conductors used between the electrical service panel and the field-supplied electrical disconnect switch do not have a current capacity less than the copper wire specified, and do not create a total voltage drop in excess of 2% of the rated voltage of the unit.

NOTE: When using aluminum conductor from the electrical service panel (power supply) to the disconnect switch (where local codes permit the use of aluminum wire), make the connections in accordance with the National Electrical Code. Prepare all aluminum wire immediately before installation by "brush-scratching" the wire, then coating the wire with a corrosion inhibitor (such as Pentrox A). Be sure that the entire connection is completely covered to prevent an electrochemical reaction that will cause the connection to fail very quickly. Do not reduce the effective size of the wire by cutting off strands to fit the wire into a connector. Always use properly sized connectors.

A. High-Voltage Connections

The unit must have a separate electrical service with a field-supplied, waterproof fused disconnect switch at, or within sight of, the unit. Refer to the unit rating plate for maximum fuse size and minimum circuit amps (ampacity) for wire sizing. Tables II and III show recommended wire sizes and lengths based on rating plate data.

The field-supplied disconnect switch box may be mounted on the unit over the high-voltage inlet hole in the control corner panel. See Figure 3 or 4. Be sure that the disconnect box does not interfere with the removal of the blower access panel.

Proceed as follows to complete the high-voltage connections to the unit:

1. Connect ground lead to chassis-ground connection when using a separate ground wire.
2. Connect high-voltage power leads to unit high-voltage pigtail leads. Single-phase units have two black pigtail leads. Three-phase units have two black and one red pigtail lead. See Figure 8, Figure 9, and unit wiring label. Use a suitable wire splice connector or wirenut to make each high-voltage connection. Tape each completed connection.

B. Special Procedures for 208-V Operation

WARNING: Make sure that the power supply to the unit is switched OFF before making any wiring changes.

When operating sizes 018 thru 036 single-phase units or sizes 036 thru 060 208/230-volt three-phase units at 208 volts, disconnect the red transformer-primary lead from the contactor. See the unit wiring label and Figure 8. Remove the tape and cover from the terminal on the end of the blue transformer-primary lead. Save the cover. Connect the blue lead to the contactor terminal from which the red lead was disconnected.

Using the cover removed from the blue lead, insulate the loose terminal on the red lead. Wrap the cover with electrical tape so that the metal terminal can not be seen.

NOTE: If a blower motor speed is changed, insulate all unused motor leads following the same procedures described for the transformer leads.

C. Low-Voltage Connections

The recommended heat pump room thermostats for heat pump operation with or without supplemental electric heaters are P/N 34427DP115 (subbase included) for automatic system changeover and P/N 34427DP118 (subbase included) for manual system changeover. These thermostats have an emergency heat (EM. HT.) switch and red indicator light.

Heat pump room thermostat P/N 34427DP87 (subbase included) can be used for heat pump operation without supplemental electric heaters. This thermostat provides for manual system changeover and does not have an emergency heat switch.

NOTE: When a supplemental electric heat package is being used, see the Installation Instructions packaged with the heater to complete system low-voltage wiring connections.

Locate the room thermostat on an inside wall in the space to be conditioned where it will not be subjected to either a cooling or heating source, or direct exposure to sunlight. Mount the thermostat 4 to 5 feet above the floor.

Use No. 18 AWG color-coded, insulated (35°C minimum) wires to make the low-voltage connections between the thermostat and the unit. If the thermostat is located more than 100 feet from the unit (as measured along the low-voltage wires), use No. 16 AWG color-coded, insulated (35°C minimum) wires.

A grommeted, low-voltage inlet hole is located in the panel adjacent to the control access panel. See Figure 3 or 4. Run the low-voltage leads from the thermostat, thru the inlet hole, and to the low-voltage terminal board. See Figure 8. Connect the low-voltage thermostat leads to the terminal

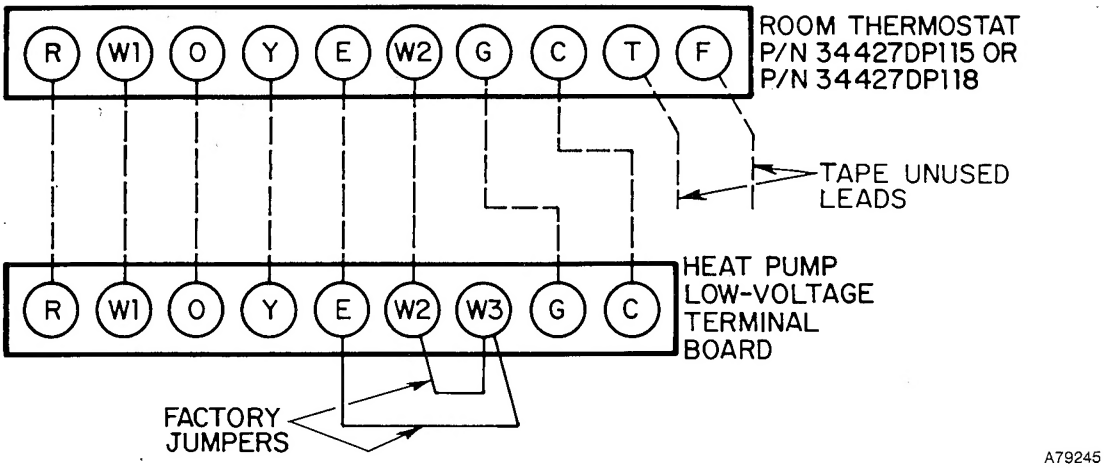


Figure 10—Field Low-Voltage Connections Using Room Thermostat P/N 34427DP115 or P/N 34427DP118

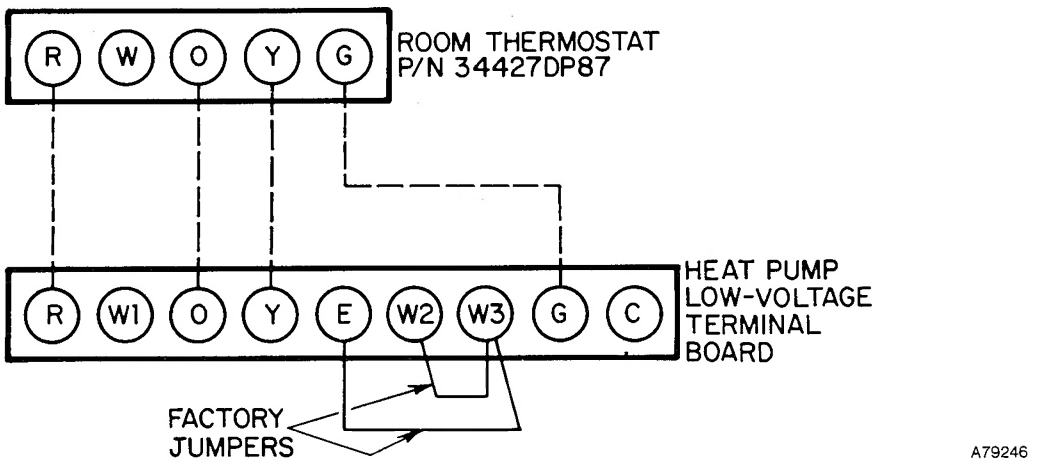


Figure 11—Field Low-Voltage Connections Using Room Thermostat P/N 34427DP87

board as shown in Figure 10 or 11, depending on which recommended room thermostat is being used.

NOTE: When using thermostat P/N 34427DP115 or 34427DP118, run a thermostat lead from each of the 10 thermostat terminals. Insulate the end of the leads that do not have a connection point in the unit.

D. Heat Anticipator Settings

The recommended room thermostats have a fixed heat anticipator for heat pump heating. When using an accessory electric heater to provide supplemental heat and emergency heat capability for the system, see the Installation Instructions packaged with the heater for setting the adjustable second-stage heat anticipator.

V. PREPARING UNIT FOR STARTUP

WARNING/DANGER: A failure to observe the following warnings could result in serious personal injury:

1. Follow recognized safety practices and wear protective goggles when checking or servicing refrigerant system.
2. Do not operate compressor or provide any electric power to unit unless compressor terminal cover is in place and secured.
3. Do not remove compressor terminal cover until all electrical sources have been disconnected.
4. Relieve all pressure from system before touching or disturbing anything inside terminal box if a refrigerant leak is suspected around compressor terminals.
5. Do not use a torch to remove any component. System contains oil and refrigerant under pressure. To remove a component, wear protective goggles and proceed as follows:
   a. Shut off electrical power to unit.
   b. Relieve all pressure from system.
   c. Cut component connecting tubing with tubing cutter and remove component from unit.
   d. Carefully unsweat remaining tubing stubs when necessary. Oil can ignite when exposed to torch flame.

A. Prestartup Procedures

Proceed as follows to inspect and prepare the unit for initial startup:

1. Remove all access panels.
2. Remove stryofoam shipping blocks from between compressor and divider panel, and between accumulator and divider panel

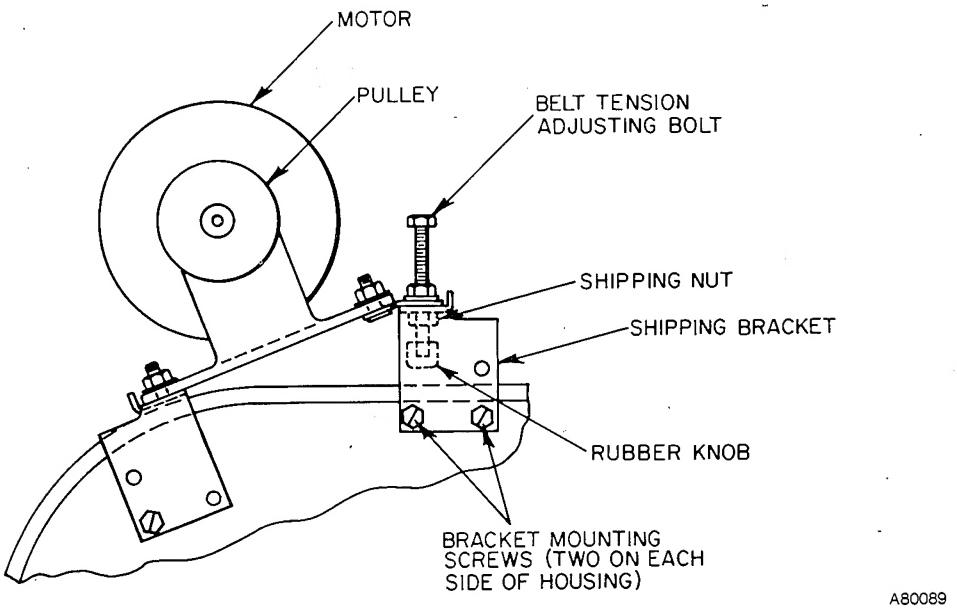


Figure 12—Removing Belt-Drive Blower Shipping Bracket

3. Read the following instructions on all WARNING, CAUTION, and INFORMATION labels attached to unit; for example, blower rotation labels, etc.
4. Refer to Figure 12 and remove shipping bracket from belt-drive blower units as follows:
   a. Locate shipping bracket mounted on blower housing.
   b. Remove two bracket mounting screws from each side of blower housing.
   c. Remove rubber knob and shipping nut from adjusting bolt.
   d. Discard shipping bracket and nut, then replace rubber knob on end of adjusting bolt.
   e. See Section VI, part C, to adjust indoor airflow.
5. Make the following inspections:
   a. Inspect for shipping and handling damages such as broken lines, loose parts, disconnected wires, etc.
   b. Inspect for oil at all refrigerant tubing connections and on unit base. Detecting oil generally indicates a refrigerant leak. Leak-test all refrigerant tubing connections, using electronic leak detector, halide torch, or liquid-soap solution. If refrigerant leak is detected, see "Refrigerant Leaks" in the next part of this section.
   c. Inspect all field and factory wiring connections. Be sure that connections are completed and tight.
   d. Inspect coil fins. If damaged during shipping and handling, carefully straighten fins with a fin comb.
6. Verify the following conditions:
   a. Make sure that outdoor fan blade is correctly positioned in fan orifice. *Blades should clear motor by 1/4 inch.*
   b. Make sure that air filter(s) is in place.
   c. Make sure that condensate drain trap is filled with water to ensure proper drainage.
   d. Make sure that all tools and miscellaneous loose parts have been removed.
7. Replace all access panels. (Unit is now ready for initial startup.)

B. Refrigerant Leaks

Proceed as follows to repair a refrigerant leak and to charge the unit:

WARNING: Never attempt to repair a soldered connection while the refrigerant system is under pressure. Severe bodily injury may result. Always wear protective goggles when servicing the refrigerant system.

1. Locate leak and ensure that refrigerant system pressure has been relieved.
2. Repair leak, following accepted practices.

NOTE: Install a filter-drier whenever the system has been opened for repair.

3. Add a small charge of R-22 refrigerant to system and leak-test unit.
4. Evacuate refrigerant system if additional leaks are not found.
5. Charge unit with R-22 refrigerant, using a volumetric charging cylinder or accurate scale. *Refer to unit rating plate for required charge.* Be sure to add extra refrigerant to compensate for the internal volume of the filter-drier.

NOTE: See Section VI, part B, for checking and adjusting refrigerant charge.

VI. STARTUP AND ADJUSTMENTS

CAUTION: Complete the required procedures given in Section V, "Preparing Unit for Startup," before starting the unit.

Do not jumper any safety devices when operating the unit.

Do not operate the compressor until electric power has been applied to the heat pump for a minimum of 4 hours to ensure that the off-cycle crankcase heater has sufficiently warmed the compressor oil to free most of the accumulated refrigerant.

Do not rapid-cycle the compressor. Allow 5 minutes between "on" cycles to prevent compressor damage.

A. Checking Unit Operation

Start and check the unit for proper operation as follows:

1. Place room thermostat SYSTEM switch in OFF position. Observe that indoor blower motor starts when FAN switch is placed in ON position and shuts down when FAN switch is placed in AUTO position.

TABLE IV—HEATING PERFORMANCE PRESSURES

Air Temp at Indoor Coil Inlet (°F DB)	Pressure Designation (Psig)	542E024 Air Temperature at Outdoor Coil (F° DB)								542E030 Air Temperature at Outdoor Coil (°F DB)								542E036 Air Temperature at Outdoor Coil (°F DB)							
		60	50	40	30	20	10	0	−10	60	50	40	30	20	10	0	−10	60	50	40	30	20	10	0	−10
65	High Side	250	229	209	190	172	155	140	127	238	218	201	184	169	155	144	134	232	214	198	183	170	158	149	142
	Low Side	69	59	49	41	33	25	18	14	71	60	50	41	32	24	18	13	64	52	46	38	31	25	18	13
70	High Side	268	243	220	199	180	162	147	134	251	231	211	195	179	165	153	142	247	230	213	198	184	171	161	152
	Low Side	70	60	50	42	34	26	19	15	72	61	51	42	33	25	19	14	65	53	47	39	31	25	19	13
75	High Side	280	256	233	211	190	172	155	140	266	246	226	207	190	176	162	151	261	243	225	209	195	182	171	162
	Low Side	71	61	51	43	35	27	20	16	73	62	52	43	34	26	20	15	66	54	48	40	32	26	19	14

Air Temp at Indoor Coil Inlet (°F DB)	Pressure Designation (Psig)	542E042 Air Temperature at Outdoor Coil (°F DB)								542E048 Air Temperature at Outdoor Coil (°F DB)								542D060 & 542E060 Air Temperature at Outdoor Coil (°F DB)							
		60	50	40	30	20	10	0	−10	60	50	40	30	20	10	0	−10	60	50	40	30	20	10	0	−10
65	High Side	254	234	216	193	171	159	148	136	262	237	214	193	174	158	144	134	268	238	210	186	166	151	142	136
	Low Side	71	62	50	42	32	24	18	14	64	56	48	40	33	26	19	13	66	56	47	39	32	24	19	13
70	High Side	268	250	230	205	183	169	156	144	278	251	226	204	184	166	154	146	284	252	224	198	178	164	154	146
	Low Side	72	63	51	43	33	25	18	14	65	57	49	41	34	27	20	13	67	57	48	40	32	25	19	13
75	High Side	283	266	243	218	194	180	166	153	290	266	242	220	201	184	169	158	298	268	238	212	190	174	162	156
	Low Side	73	64	52	44	34	26	19	14	66	58	50	42	35	28	21	14	68	58	49	41	33	25	20	14

TABLE V—COOLING PERFORMANCE PRESSURES

Air Temp at Indoor Coil Inlet (°F WB)	Pressure Designation (Psig)	542E024 Air Temp at Outdoor Coil (°F DB)										542E030 Air Temp at Outdoor Coil (°F DB)										542E036 Air Temp at Outdoor Coil (°F DB)									
		65	70	75	80	85	90	95	100	105	110	65	70	75	80	85	90	95	100	105	110	65	70	75	80	85	90	95	100	105	110
55	High Side	157	174	190	207	224	240	258	276	293	313	150	166	181	196	212	226	246	264	282	302	182	196	211	227	242	259	276	294	312	332
	Low Side	58	59	60	61	62	63	64	66	67	68	60	62	63	65	67	69	71	73	75	77	67	69	70	72	74	75	76	78	79	81
60	High Side	162	179	195	212	228	244	261	279	296	315	153	169	185	200	216	230	250	268	286	306	185	199	215	231	246	263	280	298	316	336
	Low Side	64	65	66	67	68	69	70	71	73	74	63	65	66	68	70	72	75	77	79	81	69	71	72	74	76	77	79	80	82	83
65	High Side	168	185	200	216	232	247	264	282	298	317	157	173	188	204	220	235	255	273	291	311	188	203	219	235	251	268	285	303	321	341
	Low Side	70	71	72	73	75	76	77	78	79	80	67	69	70	72	74	76	79	81	83	85	71	73	74	76	78	80	81	83	85	86
70	High Side	173	191	206	223	239	253	270	288	304	324	160	177	192	208	224	240	259	277	295	315	192	207	223	239	255	273	290	308	326	346
	Low Side	77	78	79	80	81	82	83	84	86	87	70	72	74	76	78	80	83	85	87	89	74	76	77	79	81	83	84	86	88	89
75	High Side	175	192	209	227	242	260	278	294	315	336	164	180	196	212	228	244	264	282	300	320	196	212	228	244	260	278	296	314	332	352
	Low Side	84	85	86	87	88	90	91	93	94	95	74	76	78	80	82	84	87	89	91	93	79	81	83	84	86	88	89	91	93	95

Air Temp at Indoor Coil Inlet (°F WB)	Pressure Designation (Psig)	542E042 Air Temp at Outdoor Coil (°F DB)										542E048 Air Temp at Outdoor Coil (°F DB)										542D060 & 542E060 Air Temp at Outdoor Coil (°F DB)									
		65	70	75	80	85	90	95	100	105	110	65	70	75	80	85	90	95	100	105	110	65	70	75	80	85	90	95	100	105	110
55	High Side	165	179	192	206	222	237	254	270	289	308	178	192	207	224	238	255	272	291	308	330	176	189	202	217	233	249	266	283	300	320
	Low Side	60	62	63	65	67	68	70	72	74	75	61	62	63	65	66	68	70	72	74	76	59	61	62	63	65	67	68	70	72	74
60	High Side	169	183	196	210	226	241	258	275	293	312	183	197	212	229	243	260	277	296	314	335	180	193	207	222	237	254	270	287	305	324
	Low Side	64	66	67	69	70	72	74	75	77	79	65	66	67	69	70	72	74	76	78	80	63	65	66	67	68	70	71	73	75	77
65	High Side	173	187	201	215	231	246	263	280	298	317	188	203	218	235	249	266	283	302	320	340	185	198	212	227	242	259	275	292	310	329
	Low Side	68	69	71	73	74	76	78	79	81	83	69	70	71	73	74	76	78	80	82	84	67	69	70	71	72	74	75	76	78	80
70	High Side	177	191	205	220	235	251	268	285	303	322	193	208	223	240	254	271	288	307	326	345	191	205	219	234	250	266	283	301	319	338
	Low Side	72	73	75	77	78	80	82	83	85	87	73	74	75	77	78	80	82	84	86	88	71	73	74	75	77	79	80	81	83	85
75	High Side	181	196	210	225	240	256	273	290	308	327	198	214	229	246	260	277	294	312	332	350	198	212	227	242	258	274	292	310	328	346
	Low Side	76	77	79	81	82	84	86	87	89	91	77	78	80	81	83	84	86	88	90	92	76	77	79	80	82	84	85	87	89	91

2. Place SYSTEM switch in COOL position and FAN switch in AUTO position. Set thermostat cooling control below room temperature to start cooling cycle. Observe that compressor, outdoor fan, and indoor blower motors start. Observe that unit shuts down when control setting is satisfied. Wait 5 minutes for pressures to equalize.
3. Place SYSTEM switch in HEAT position, and leave FAN switch in AUTO position. Increase thermostat heating control setting gradually until thermostat "calls" for heat. Observe that compressor, outdoor fan, and indoor blower motor start. If supplemental electric heater is being used in the system, increase thermostat heating control setting an additional 6 degrees. Observe that the supplemental electric heater energizes. Set control setting below room temperature, and observe that heater deenergizes and that heat pump shuts down.
4. If supplemental electric heater is being used in the system, leave FAN switch in AUTO position, SYSTEM switch in HEAT position, and move emergency heat switch from NORM. position to EM. HT. position. Set thermostat control setting above room temperature to start heating cycle. Observe that all supplemental electric heat is energized, that indoor blower motor starts, that emergency heat indicator bulb lights, and that compressor and outdoor fan do not start. When control setting is satisfied, observe that heater deenergizes and that blower motor stops; however, indicator light should remain on as long as emergency heat switch is in EM. HT. position.
5. If autochangeover thermostat P/N 34427DP115 is being used, place both SYSTEM and FAN switches in AUTO position. Observe that heat pump operates in heating mode when heating control selector is set above room temperature, and operates in cooling mode when cooling control selector is set below room temperature.

B. Checking and Adjusting Refrigerant Charge

The refrigerant system is fully charged with R-22 refrigerant, tested, and factory-sealed. For most applications, the factory charge is the correct amount for the best performance; however, this charge may require a slight adjustment to attain rated performance.

NOTE: Adjustment of the refrigerant charge is not required unless the unit is suspected of not having the proper charge.

An operating pressure/temperature tag is fastened inside the compressor compartment. (Also see Tables IV and V.) Use this tag to approximate the charge if ARI rating conditions can not be obtained, when evaluating the refrigerant charge by checking operating pressures and temperatures. This method of evaluating ensures that an optimum refrigerant charge is in the system when the system conditions and components are normal; however, adjusting the refrigerant charge does not solve or fix system abnormalities.

The amount of refrigerant charge affects how efficiently and economically the unit operates. An overcharged or undercharged unit leads to diminished efficiency, high operating costs, and the possibility of premature compressor failure.

CAUTION: When evaluating the refrigerant charge, an indicated adjustment to the specified factory charge must always be very minimal. If a substantial adjustment is indicated, an abnormal condition exists somewhere in the system; such as insufficient airflow across either coil or both coils.

When checking the refrigerant using the temperature/pressure evaluation method, adhere to the following criteria:

1. Check refrigerant charge in cooling mode when outdoor temperature is above 65°F.
2. Check refrigerant charge in heating mode when outdoor temperature is below 65°F.
3. For best results, do not operate unit continuously for more than 10 minutes if for any reason charge must be checked in opposite mode above or below 65°F.

Proceed as follows to evaluate the system performance and refrigerant charge:

1. Remove caps from low- and high-pressure service fittings. See Figure 8.
2. Attach low- and high-side pressure gauge hoses to low- and high-pressure service fittings, respectively. *Hoses must have valve core depressors. Gauges must be calibrated for accuracy.*
3. Set room thermostat below room temperature to start cooling operation or above room temperature to start heating operation, depending on outdoor temperature. Allow unit to operate until conditions stabilize and pressures level out.
4. Determine and record these conditions:
   a. Low- and high-side pressures.
   b. *Dry-bulb* temperature of inlet air at outdoor coil.
   c. Temperature of inlet air at return-air grille—*wet bulb if operating in cooling mode or dry bulb if operating in heating mode.*
5. Evaluate system performance and refrigerant charge by comparing recorded reading with operating pressure/temperature tag.
6. Make slight adjustment to refrigerate charge when necessary.

NOTE: If the problem causing the inaccurate readings is a refrigerant leak, see Section V, part B, of these instructions.

C. Indoor Airflow & Airflow Adjustments

CAUTION: The recommended indoor airflow is 350 to 450 ft^3/min per each 12,000 Btuh of rated unit capacity. Inadequate airflow can cause unsatisfactory operation and performance.

Model 542E, sizes 024 thru 048, and single-phase 060-size units have direct-drive blower motors. All motors have a high- and low-speed connection (except for 460-V motors which have only a high-speed connection).

The system airflow for all direct-drive units (except 460-V) can be changed, when necessary, by changing the blower motor speed connection from the factory setting to the unused speed connection. The factory setting is indicated on the unit wiring label. For operation of units designed for 208-V and 230-V operation, a blower motor speed connection may need to be changed. See unit wiring label. See Section IV, part B, for the procedure.

Model 542D060 and 542E060 3-phase units have belt-drive blower motors. The system airflow for these units can be changed, when necessary, by adjusting the blower-motor pulley as follows:

CAUTION: Increasing the blower speed places a heavier load on the motor and increases the current. Do not exceed the rated full load amperage indicated on the rating plate of the blower motor.

1. Turn off power at disconnect switch.
2. Relieve belt tension, then remove drive belt from motor pulley.
3. Loosen setscrew in movable flange on motor pulley and turn flange either *in to increase airflow* or *out to decrease airflow.*
4. Make sure that setscrew is over flat surface on pulley hub and tighten setscrew.
5. Replace belt and adjust belt tension for approximately one inch of sag under normal finger pressure midway between pulleys.

Tables VI and VII show the air delivery performance at various external static pressues. Determine the airflow for the system being installed as follows:

1. Start the unit and measure static pressure in duct system at unit.
2. Refer to Table VI or VII and determine airflow at static pressure measured.

NOTE: Be sure that all supply- and return-air grilles are open, free from obstructions, and adjusted properly.

When using an accessory electric heater, the system airflow can also be determined by measuring the temperature rise through the unit, then using the following formula:

$$\text{AIRFLOW } (ft^3/min) = \frac{KW}{TR} \times Y$$

where,
KW = Heater nominal KW at 240 or 480V
TR = Measured temperature rise
Y =

200V	208V	220V 440V	230V 460V	240V 480V
2195	2374	2655	2902	3160

NOTE: Value Y varies with the operating voltage at the heater. Interpolate to determine the value of Y for voltages not shown.

CAUTION: When using an accessory electric heater, the system airflow must be sufficient to prevent the heater limit switches from tripping off. When using the 20-KW single-phase heater, the system airflow must be at least 1000 ft^3/min.

TABLE VI—AIR DELIVERY (Ft³/Min) AT INDICATED EXTERNAL STATIC PRESSURE & VOLTAGE*

Model	Blower Motor Speed	Operating Voltage	Application†	External Static Pressure—Inches wc							
				0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
542E024	Low	208	Heating	880	835	790	740	690	630	565	470
			Cooling	850	810	770	725	675	615	550	465
		230	Heating	965	925	880	835	780	720	655	575
			Cooling	940	900	855	810	755	700	635	560
	High	208	Heating	1015	970	920	870	815	750	685	605
			Cooling	985	940	890	840	785	730	665	585
		230	Heating	1070	1030	985	940	885	830	765	680
			Cooling	1040	1000	955	910	855	800	735	660
542E030	Low	208	Heating	995	965	930	890	845	785	705	590
			Cooling	980	945	910	865	820	760	680	560
		230	Heating	1070	1050	1025	995	960	915	840	730
			Cooling	1055	1030	1005	970	930	880	800	680
	High	208	Heating	1165	1145	1125	1095	1065	1020	955	845
			Cooling	1150	1130	1105	1075	1035	980	900	770
		230	Heating	1260	1245	1225	1200	1165	1125	1065	970
			Cooling	1245	1225	1200	1170	1135	1080	1005	875
542E036	Low	208	Heating	1280	1235	1185	1135	1080	1020	955	875
			Cooling	1225	1185	1140	1095	1040	985	920	850
		230	Heating	1485	1435	1380	1325	1265	1200	1115	1025
			Cooling	1400	1350	1300	1250	1190	1125	1050	970
	High	208	Heating	1685	1630	1575	1510	1440	1360	1275	1160
			Cooling	1565	1510	1455	1395	1325	1250	1160	1045
		230	Heating	1850	1785	1720	1650	1575	1490	1395	1280
			Cooling	1670	1615	1560	1495	1425	1345	1250	1100
542E042	Low	208	Heating	1400	1360	1315	1265	1205	1130	1015	—
			Cooling	1370	1330	1280	1230	1165	1085	955	—
		230	Heating	1655	1610	1560	1505	1435	1360	1270	1140
			Cooling	1615	1565	1510	1450	1380	1305	1205	1050
	High	208	Heating	1895	1840	1780	1715	1645	1570	1480	1365
			Cooling	1825	1770	1710	1645	1570	1490	1395	1270
		230	Heating	2125	2065	2005	1935	1860	1775	1685	1570
			Cooling	2030	1970	1905	1835	1760	1675	1575	1440
542E048	Low	208	Heating	1690	1635	1575	1510	1440	1360	1270	1140
			Cooling	1650	1595	1535	1475	1405	1325	1230	1100
		230	Heating	1905	1855	1800	1740	1675	1600	1510	1370
			Cooling	1860	1810	1755	1690	1625	1545	1445	1290
	High	208	Heating	2005	1955	1900	1845	1780	1705	1625	1510
			Cooling	1955	1905	1850	1790	1725	1650	1560	1430
		230	Heating	2270	2195	2120	2040	1955	1870	1765	1650
			Cooling	2180	2110	2040	1960	1880	1785	1685	1570
		460	Heating	2070	2000	1925	1845	1760	1665	1560	1425
			Cooling	2000	1930	1855	1775	1690	1595	1490	1355
542E060 (Single-Phase Units)	Low	230	Heating	2250	2205	2160	2110	2050	1990	1915	1830
			Cooling	2180	2135	2085	2030	1970	1900	1815	1700
	High	230	Heating	2700	2625	2550	2465	2380	2285	2175	2055
			Cooling	2550	2475	2395	2315	2220	2120	2005	1860

*Deduct field-supplied air filter pressure drop & heater loss (when used) to obtain available external static pressure for ducting.
†Heating airflow values are with a dry coil. Cooling airflow values are with a wet coil.
NOTE: Shaded portions of this table fall below 350 ft³/min per 12,000 Btuh of rated cooling capacity. Indoor coil icing may ocur at airflows below this point. Dashes are used in those areas of the table that fall beyond the capability of the indoor blower motor.

D. Unit Controls

All compressors have the following internal protection controls:

1. *High-Pressure Relief Valve*—This valve opens when the pressure differential between the low and high side becomes excessive.
2. *Compressor Overload*—This internal overload interrupts power to the compressor windings when either the current or internal temperature become excessive, and automatically resets when the internal temperature drops to a safe level. This overload may require up to 60 minutes (or longer) to reset; therefore if the internal overload is suspected of being open, disconnect the electrical power to the unit and check the circuit thru the overload with an ohmmeter or continuity tester.
3. *Low-Pressure Switch*—This switch with automatic reset interrupts the compressor control circuit when the refrigerant high-side pressure becomes too low. It protects the compressor from damage attributable to loss of the refrigerant charge.
4. *Time/Temperature Defrost System*—The defrost control system consists of a defrost timer, a defrost thermostat switch, and a defrost relay. The system initiates defrost cycle operation every 90 minutes if a coil icing condition exists. See the defrost cycle sequence of operation in Section VII.
5. *Crankcase Heater*—This device prevents overdilution of compressor oil with refrigerant during shutdown periods, thereby extending the life of the compressor. See the crankcase heater sequence of operation in Section VII.
6. *Compressor Quick-Start Components*—These components are used with all single-phase units to improve compressor starting characteristics.

TABLE VII—MODEL 542D060 & 542E060—3-PHASE UNITS—MOTOR PULLEY SETTINGS FOR AIR DELIVERY AT INDICATED EXTERNAL SP & VOLTAGE WITH WET COIL

542E060 STANDARD DRIVE RANGE							
208 Volts—Standard Motor Pulley & Belt							
Airflow	0.30	0.40	0.50	0.60	0.70	0.80	0.90
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	—	—	4-1/2	3-1/2	2-1/2	2
1875	—	—	5	4	3	2-1/2	1
2000	-	-	4-1/2	3-1/2	2-1/2	2	1/2
2125	—	5	4	3	2	1	—
2250	—	4-1/2	3-1/2	2-1/2	1-1/2	1/2	—
230 Volts—Standard Motor Pulley & Belt							
Airflow	0.40	0.45	0.50	0.55	0.60	0.65	0.70
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	—	—	5	4-1/2	4	3-1/2
1875	—	—	—	4-1/2	4	3-1/2	3
2000	—	5	4-1/2	4	3-1/2	3	3
2125	5	4-1/2	4	3-1/2	3-1/2	3	2-1/2
2250	4-1/2	4	4	3-1/2	3	2-1/2	2
460 Volts—Standard Motor Pulley & Belt							
Airflow	0.30	0.40	0.50	0.60	0.70	0.80	0.90
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	—	—	5	3-1/2	3	2
1875	—	—	—	4	3	2	1-1/2
2000	—	—	5	4	3	2	1
2125	—	—	4-1/2	3-1/2	2	1-1/2	1/2
2250	—	5	4	3	2	1	—
542E060 OPTIONAL DRIVE RANGE							
208 Volts—Optional Motor Pulley & Belt							
Airflow	0.20	0.25	0.30	0.35	0.40	0.45	0.50
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1600	5	4	3	2-1/2	2	1-1/2	1
1650	4-1/2	3-1/2	3	2	1-1/2	1-1/2	1
1700	4	3	2-1/2	2	1-1/2	1	1/2
1750	3-1/2	3	2-1/2	2	1-1/2	1	1/2
1800	3-1/2	3	2	1-1/2	1	1/2	0
230 Volts—Optional Motor Pulley & Belt							
Airflow	0.20	0.25	0.30	0.35	0.40	0.45	0.50
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1600	5	4	3	2-1/2	2	1-1/2	1
1650	4-1/2	3-1/2	3	2	2	1-1/2	1
1700	4	3	2-1/2	2	1-1/2	1	1/2
1750	4	3	2-1/2	2	1-1/2	1	1/2
1800	3-1/2	3	2	2	1	1	1/2
460 Volts—Optional Motor Pulley & Belt							
Airflow	0.20	0.25	0.30	0.35	0.40	0.45	0.50
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1600	4	3-1/2	3	2-1/2	2	1-1/2	1
1650	4	3	2-1/2	2	1-1/2	1	1/2
1700	3-1/2	3	2-1/2	2	1-1/2	1	1/2
1750	3-1/2	3	2-1/2	2	1	1	1/2
1800	3-1/2	2-1/2	2	1-1/2	1	1/2	0
542D060 STANDARD DRIVE RANGE							
208 Volts—Standard Motor Pulley & Belt							
Airflow	0.10	0.20	0.30	0.40	0.50	0.60	0.70
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	4	3-1/2	3	2	1-1/2	1
1875	5	3-1/2	3	2	1-1/2	1/2	0
2000	4	2-1/2	2	1	1	0	—
2125	2-1/2	2	1	1/2	0	—	—
2250	2	1	1/2	—	—	—	—
230 Volts—Standard Motor Pulley & Belt							
Airflow	0.10	0.20	0.30	0.40	0.50	0.60	0.70
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	5	4	3	2-1/2	1-1/2	1
1875	5	4	3	2	1-1/2	1	0
2000	4	3	2	1-1/2	1	0	—
2125	3	2	1-1/2	1-1/2	0	—	—
2250	2	1	1/2	0	—	—	—
460 Volts—Standard Motor Pulley & Belt							
Airflow	0.10	0.20	0.30	0.40	0.50	0.60	0.70
(Ft³/Min)	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.	T.O.
1750	—	5	4	3-1/2	2-1/2	1-1/2	1
1875	5	4-1/2	3-1/2	2-1/2	2	1	1/2
2000	4	3	2-1/2	1-1/2	1	1/2	—
2125	3	2	1-1/2	1	0	—	—
2250	2	1-1/2	1/2	0	—	—	—

NOTES:

1. Values shown for Model 542E are without air filter. Values shown for Model 542D are with factory-supplied 1-inch air filters. Use values shown for Model 542D when using the accessory field-installed downflow plenium with Model 542E.
2. **T.O.** = Blower motor pulley turns open.
3. Dashes indicate portions of the table that are beyond the drive range.
4. Optional drive for Model 542E060: motor pulley P/N 50611B6 & belt P/N 94006
5. Motor pulley factory setting is two turns open.

7. *Outdoor Fan Thermostat*—This control, which is featured on all 3-phase units, maintains the proper cooling mode condensing temperature by switching the outdoor fan motor to high- or low-speed operation. Low-speed fan operation permits low-ambient cooling operation down to 40°F outdoor temperature.

VII. SEQUENCE OF OPERATION

Do not leave the installation until the heat pump has been observed throughout one or two complete cycles. The installer should make certain during this time that all components are operating in correct sequence.

The sequences of operation described in this section pertain to size 036, 042, and 048 208/230-volt, 3-phase units; however, the sequence of operation of all units is very similar. Refer to the line-to-line wiring diagram in Figure 13.

NOTE: Although the actual unit wiring may vary slightly from that shown in Figure 13, the sequence of operation will not be affected. The sequences of operation described in this section pertain to a typical system using room thermostat P/N 34427DP115 or P/N 34427DP118 for system control, and using an accessory electric resistance heater for supplemental heat.

NOTE: The indoor blower motor will operate continuously, regardless of the room thermostat SYSTEM switch position, when the FAN switch is in the ON position. The ON position of the FAN switch keeps the circuit through blower relay coil 2A closed and the coil energized. When the FAN switch is in the AUTO position, the blower operates only when the system is started by the room thermostat demand for heating or cooling.

A. Crankcase Heater Operation

Compressor crankcase heater 11A is connected across normally open cmpressor contactor 2D contacts between 13 and 23. When electric power is supplied to the heat pump, and the unit is not operating in either the heating or cooling mode, a completed circuit between power legs L1 and L3 permits current to flow through one leg of compressor motor 3F windings and through crankcase heater 11A. The high electrical resistance of the crankcase heater causes the heater to heat up, while the compressor motor windings serve only as a means of completing the circuit between L1 and L3.

When the heat pump receives a "call" for either heating or cooling, normally open compressor contactor 2D contacts between 13 and 23 close. (See heating and cooling sequences of operation in this section.) Electric current, which always follows the path of least resistance, flows through the closed contacts and through both compressor motor 3F and outdoor fan motor 3D1. The crankcase heater, which offers a much higher electrical resistance than the two motors, receives virtually no electrical current as long as the contactor is energized.

B. Cooling Operation

With the room thermostat SYSTEM switch in the COOL position and the FAN switch in the AUTO position, the cooling sequence of operation is as follows:

When the room temperature rises to within 2 degrees of the cooling control setting of room thermostat, the thermostat cooling operation bulb tilts and connects thermostat terminal R to thermostat terminal O. This completed circuit through the thermostat completes the circuit through unit terminal O. Reversing valve solenoid coil 5B and outdoor fan relay coil 2C are now connected across the 24-volt secondary of unit transformer 1B.

Energized solenoid coil 5B switches the reversing valve from the normal heating mode position to the cooling mode position. Energized outdoor fan relay coil 2C closes its set of normally open contacts between 1 and 3, and opens its set of normally closed contacts between 1 and 2, permitting two-speed outdoor fan motor 3D1 to operate on either high or low speed, depending on the outdoor ambient temperature.

NOTE: When the contacts of outdoor fan relay 2C are in their normal heating mode positions as shown in Figure 13, fan motor 3D1 operates on high speed, regardless of the outdoor ambient temperature.

The heat pump is now in the "standby" condition and ready to operate in the cooling mode when the room thermostat "calls" for cooling.

When the room temperature rises to a point that is slightly above the cooling control setting of the thermostat, the thermostat cooling bulb tilts and thermostat terminal R is automatically connected to thermostat terminals G and Y. These completed circuits through the thermostat connect indoor blower relay coil 2A (through unit terminal G) and compressor contactor coil 2D (through unit terminal Y) across the 24-volt secondary of transformer 1B.

The set of normally open contacts of energized relay 2A between 1 and 3 closes and completes the circuit through indoor blower motor 3D2. The motor starts instantly.

The two sets of normally open contacts of energized contactor 2D between 13 and 23, and 11 and 21, close and complete the circuit through compressor motor 3F and outdoor fan motor 3D1. Both motors start instantly. The current flow through outdoor fan motor 3D1 also flows through fan switching thermostat 7K, which maintains the optimum cooling mode condensing temperature by switching the fan motor to high- or low-speed operation, depending on the outdoor ambient temperature.

The heat pump is now operating in the cooling mode. The energized reversing valve is directing the high-temperature, high-pressure discharge gas to the outdoor coil, where the heat is transferred to the outdoor air.

All three energized motors continue to run and the cooling cycle remains "on" until the room temperature drops to a point that is slightly below the cooling control setting of the room thermostat. At this point, the thermostat cooling bulb tilts and breaks the circuit between thermostat R to terminals G and Y. These open circuits deenergize indoor blower relay coil 2A and compressor contactor coil 2D. All closed contacts return to their normally open position, and all three motors stop.

The heat pump has now returned to a "standby" condition, awaiting another "call" for cooling by the room thermostat. If the room temperature continues to fall, the thermostat cooling operation bulb will tilt and break the circuit between thermostat terminals R and O. This open circuit deenergizes reversing valve solenoid coil 5B and outdoor fan relay coil 2C. The fan relay contacts open, and the reversing valve switches to the normal heating mode position.

Except for the crankcase heater, all heat pump components are now deenergized. When the room temperature rises again and reaches the room thermostat control points, the cooling sequence will start again. If the room temperature continues to drop, the heat pump will remain "off", and the heating mode will not start until the room thermostat SYSTEM switch is moved to the HEAT position (either HEAT or AUTO when using autochangeover thermostat P/N 34427DP115).

C. Heating Operation

With the room thermostat SYSTEM switch in the HEAT position and the FAN switch in the AUTO position, the heating sequence of operation is as follows:

When the room temperature drops to a point that is slightly below the heating control setting of the thermostat, the thermostat first-stage heating bulb "tilts" and thermostat terminal R is automatically connected to thermostat terminals G and Y. These completed circuits through the thermostat connect indoor blower relay coil 2A (through unit terminal G) and compressor contactor coil 2D (through unit terminal Y) across the 24-volt secondary of transformer 1B.

The set of normally open contacts of energized relay 2A between 1 and 3 closes and completes the circuit through indoor blower motor 3D2. The motor starts instantly.

The two sets of normally open contacts of energized contactor 2D between 13 and 23, and 11 and 21, close and complete the circuit through compressor motor 3F and outdoor fan motor 3D1. Both motors start instantly. Outdoor fan motor 3D1 operates on high speed, regardless of the outdoor temperature, because outdoor fan relay contacts 2C are in their normal heating mode positions, as shown in Figure 13. In these normal positions, the line-voltage circuit to fan motor 3D1 is always to the high-speed motor windings, regardless of the switching action of fan switching thermostat 7K.

The heat pump is now operating in the heating mode. The nonenergized reversing valve is in the normal heating mode position and the high-temperature, high-pressure discharge gas is being directed to the indoor coil, where the heat is transferred to the indoor air.

All three energized motors continue to run, and the heating cycle remains "on" until the room temperature rises to a point that is slightly above the heating control setting of the room thermostat. If the outdoor temperature has dropped to the point where the heating capacity of the heat pump can not maintain the desired indoor room temperature, the second-stage heating bulb will tilt when the indoor temperature continues to drop to a point that is slightly below the factory differential setting of the room thermostat. Thermostat terminal R is automatically connected to thermostat terminals W1 and W2. These completed circuits through the thermostat connect the relay coil (or coils if using a two- or three-bank heater) of the supplemental electric heater across the 24-V secondary of heat pump transformer 1B. The electric heater energizes to provide supplemental electric heat to the system.

NOTE: See the Installation Instructions packaged with the electric heater for a more comprehensive description of the electric heater sequence of operation.

When the room temperature rises to a point that is slightly above the second-stage control setting, the second-stage heating bulb will tilt and break the circuit between thermostat terminal R to terminals W1 and W2. The supplemental electric heat deenergizes. When the room temperature continues to rise to a point that is slightly above the heating control setting of the room thermostat, the first-stage heating bulb tilts and breaks the citcuits between thermostat terminal R to terminals G and Y. These open circuits

deenergize indoor blower relay coil 2A and compressor contactor coil 2D. All closed contacts return to their normally open position and all three motors stop.

The heat pump has now returned to a "standby" condition awaiting another "call" for heating by the room thermostat. Except for the crankcase hater, all heat pump components are now deenergized. If the room temperature continues to rise, the heat pump will remain "off" and the cooling mode will not start until the room thermostat SYSTEM switch is moved to the COOL position (either COOL or AUTO when using autochangeover thermostat P/N 34427DP115).

D. Defrost Cycle

The defrost control circuit consists of defrost timer 3M, defrost thermostat switch 7M, and defrost relay 2P. The defrost timer is factory-set for 90-minute intervals of elapsed running time, which results in optimum heating mode efficiency for most installations; however, the adjustable cam can be reset for a 30-minute interval when abnormal climatic conditions dictate. These conditions include excessive outdoor humidity at low outdoor temperatures or any condition that results in frequent incomplete defrosting.

CAUTION: Never adjust the factory-set 90-minute interval unless an observed defrosting problem exists. An occasional deposit of frost on the outdoor coil, after a full 10-minute time-terminated defrost cycle, does not indicate that a problem exists. Frequent deposits of frost on the outdoor coil that occur throughout a wide range of outdoor temperatures indicate that a problem does exist.

With the heat pump operating in the heating mode, the defrost cycle sequence of operation is as follows:

Defrost thermostat 7M switches to the closed position when the outdoor coil refrigerant temperature drops to approximately 30°F. When defrost timer 3M completes 90 minutes of elapsed running time, the normally open timer contacts between 3 and 4 close for approximately 10 seconds. If defrost thermostat is not closed during the 10-second interval, the defrost cycle does not begin and the defrost control does not "look" for frost for another 90 minutes of elapsed running time.

When normally open defrost timer contacts between 3 and 4 close for their 10-second interval, and defrost thermostat switch 7M has switched close, the defrost control circuit is completed and defrost relay coil 2P is energized.

Energized defrost relay coil 2P switches all of its contacts and each of the following events occur simultaneously:

1. Normally open, high-voltage, defrost relay contacts between 7 and 9 close before defrost timer 3M contacts between 3 and 4 complete their 10-second interval. The defrost control circuit is maintaned and defrost relay coil 2P remains energized.
2. Normally closed, high-voltage, defrost relay contacts between 7 and 8 open and the circuit through outdoor fan motor 3D1 is broken. The motor stops running.
3. Normally open, low-voltage, defrost relay contacts between 1 and 3 close and complete the circuit to reversing valve solenoid 5B. The reversing valve switches from the normal heating mode position to the cooling mode position and the hot discharge gas is directed to the outdoor coil to melt the frost on the coil.
4. Normally open, low-voltage, defrost relay contacts between 4 and 6 close. Unit terminal R is now connected to unit terminal W1 and the first bank of supplemental electric heat is automatically energized. Terminals W1 and W2 of the room thermostat are internally connected; therefore, any additional banks of supplemental electric heat are also automatically energized.

The system is now heating the conditioned space with the supplemental heaters while the outdoor coil is defrosting. When the outdoor coil refrigerant temperature rises to approximately 67°F, defrost thermostat 7M switches to the open position to terminate the defrost cycle; however, if the defrost thermostat 7M has not terminated the defrost cycle within a 10-minute interval, normally closed timer 3M contacts between 3 and 5 automatically open and terminate the defrost cycle.

When the defrost cycle is terminated by either the defrost thermostat or the timer contacts, defrost relay 2P is deenergized. Outdoor fan motor 3D1 restarts and reversing valve solenoid 5B is deenergized. The reversing valve switches to the nrmal heating mode position. The supplemental electric heaters are deenergized if the room thermostat is not "calling" for second-stage heating.

The system has now returned to normal heating mode operation. After 90 minutes of elapsed running time, defrost timer 3M will automatically make another check to determine if the outdoor coil requires defrosting.

E. Emergency Heat Operation

Thermostats P/N 34427DP115 and 34427DP118 have an emergency heat switch (EM. HT.) which can be used if there is a heat pump malfunction. When the switch is moved from the NORM. position to the EM. HT. position, the compressor and outdoor fan are deenergized, and the unit operates on electrical resistance heat only.

F. Automatic Changeover Operation

When using autochangeover thermostat P/N 34427DP115, switching to either heating or cooling is automatically controlled by the room thermostat when the SYSTEM switch is in the AUTO position.

To prevent unwanted cycling between heating and cooling mode operation, the heating and cooling temperature selection levers provide for a 4°F minimum temperature setting differential. For most installations, this differential will probably be set closer to 10°F to comply with recommended guidelines for energy conservation.

With both the SYSTEM and FAN switches in the AUTO position, the heat pump will start operation in the heating mode when the room temperature drops to a point that is slightly below the heating control setting, or will start operation in the cooling mode when the room temperature rises to a point that is slightly above the cooling control setting.

VIII. CARE AND MAINTENANCE

To ensure continuing high performance, and to minimize the possibility of premature equipment failure, periodic maintenance must be performed on this equipment. This packaged heat pump should be inspected at least once each year by a service person who is properly trained and equipped.

NOTE TO EQUIPMENT OWNER: Consult your local Dealer about the availability of a maintenance contract.

WARNING: The ability to properly perform maintenance on this equipment requires certain expertise, mechanical skills, tools, and equipment. If you do not possess these, do not attempt to perform any maintenance on this equipment other than routine filter maintenance. A FAILURE TO HEED THIS WARNING COULD RESULT IN SERIOUS PERSONAL INJURY AND POSSIBLE DAMAGE TO THIS EQUIPMENT.

The minimum maintenance requirements for this equipment are as follows:

1. Inspect air filter(s) each month. Clean or replace when necessary.

LEGEND

1B-Transformer
2A-Indoor Blower Relay SPST (N.O.)
2C-Outdoor Fan Relay SPDT
2D-Compressor Contactor DPST (N.O.)
2P-Defrost Relay TPDT
3D1-Outdoor Fan Motor
3D2-Indoor Blower Motor
3F-Compressor
3M-Defrost Timer
4A1-Fan Motor Capacitor
4A2-Blower Motor Capacitor
5B-Reversing Valve Solenoid
7K-Fan Switching Thermostat SPDT
7M-Defrost Thermostat Switch (N.O.)
7P-Low-Pressure Switch SPST (N.O.)
11A-Crankcase Heater

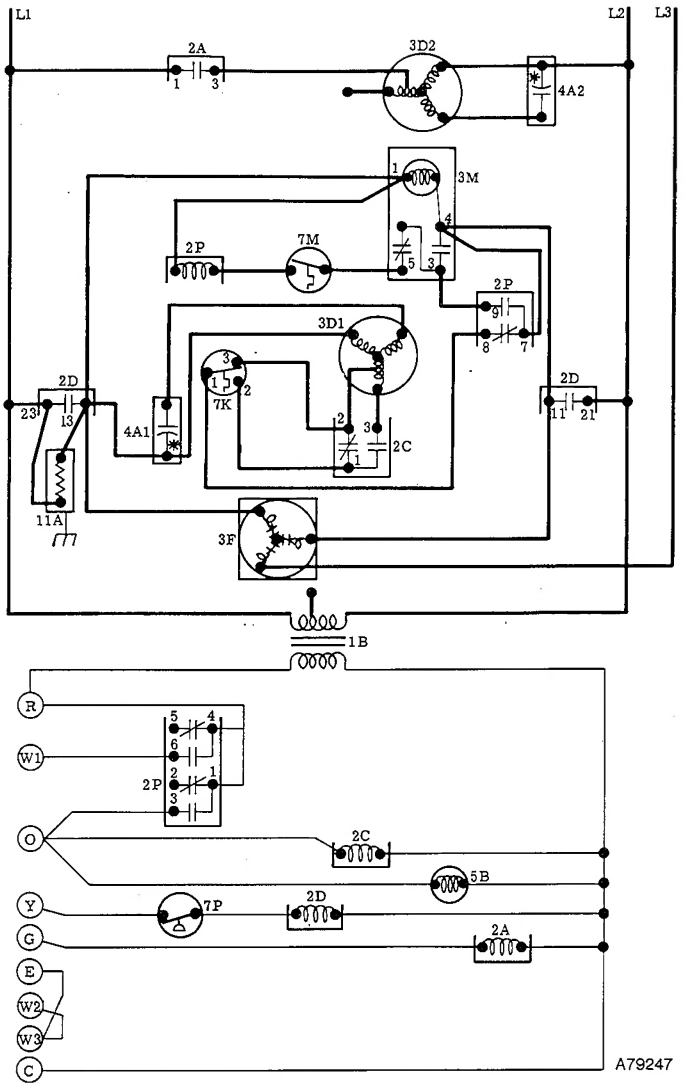


Figure 13—Typical Line-to-Line Wiring Diagram

2. Inspect coils, drain pan, and condensate drain annually. Clean when necessary.
3. Inspect blower motor and wheel for cleanliness, and check lubrication annually. Clean and lubricate when necessary.
4. Check electrical connections for tightness and controls for proper operation annually. Service when necessary.

WARNING: A failure to follow these warnings could result in serious personal injury:

1. Disconnect electrical power to the unit before performing any maintenance or service on the unit. (There may be more than one disconnect switch.)
2. Use extreme caution when removing panels and parts. As with any mechanical equipment, personal injury can result from sharp edges, etc.

A. Unit Top Removal

WARNING: Removal of the unit top must never be attempted by anyone other than qualified technicians.

CAUTION: The outdoor fan and motor are fastened to the unit top. When removing the top, use extreme care to not pull the fan motor leads loose.

NOTE: When performing maintenance or service procedures that require removal of the unit top, be sure to perform *all* of the routine maintenance procedures that require top removal; including coil inspection and cleaning, and condensate drain pan inspection and cleaning.

When performing maintenance and service procedures that require unit top removal, refer to the following top removal procedures:

1. Disconnect electric power to unit.
2. Remove all screws that secure unit top, including screws around four sides and those on top that screw into internal divider panels. Save all screws.
3. Tape all side panels at each seam near unit top. Use tape strips that are at least 5 inches long to prevent sides from falling when top is removed.
4. Lift top from unit carefully. Set top on edge and ensure that top is supported by unit side that is opposite duct (or plenum) side. *Use extreme care to prevent damage to fan blades, motor, insulation, and coils.*
5. Carefully replace and secure unit top to unit, using screws removed in step 2 when maintenance and/or service procedures are concluded. (Be sure to use original screws that have rubber washers to seal out water when securing top to internal divider panels.)

B. Air Filter

CAUTION: Never operate the unit without a suitable air filter in the return-air duct system. Always replace the filter with the same size and type. See Table I for recommended filter sizes.

Inspect air filter(s) at least once each month and replace (disposable-type) or clean (cleanable-type) at least twice during each heating and cooling season or whenever the filter(s) become clogged with dust and lint.

Model 542E units do not have factory-supplied air filters. The field-supplied air filter(s) may be either disposable or cleanable. Model 542D units have two factory-supplied, disposable-type air filters located in the plenum section of the unit. Remove the access door on the return-air inlet side of the plenum to gain access to the filters. See Figure 4. Replace these filters with the same size and type when necessary.

C. Direct-Drive Indoor Blower and Motor

For longer life, operating economy, and continuing efficiency; clean accumulated dirt and grease from the blower wheel and motor annually.

Lubricate the motor every 5 years if the motor is used intermittently (thermostat FAN switch in AUTO position), or every 2 years if the motor is used continuously (thermostat FAN switch in ON position).

WARNING: Disconnect electrical power to the unit before cleaning and lubricating the blower motor and wheel.

Clean and lubricate the direct-drive blower motor and wheel as follows:

1. Remove and disassemble blower assembly as follows:
   a. Remove blower and control access panels.
   b. Refer to unit wiring label and disconnect blower motor leads from their termination points in unit control box. (Be sure to mark wiring label appropriately if lead terminations were changed to adjust indoor airflow and changes were not previously marked.)
   c. Remove blower assembly from unit. Be careful not to tear insulation in blower compartment.
   d. Ensure proper reassembly by marking blower wheel and motor in relation to blower housing before disassembly.
   e. Loosen setscrew(s) that secures wheel to motor shaft, remove screws that secure motor mount brackets to housing, and slide motor and motor mount out of housing.
2. Lubricate motor as follows:
   a. Thoroughly clean all accumulations of dirt or grease from motor housing.
   b. Remove dust caps or plugs from oil ports located at each end of motor.
   c. Use a good grade of SAE 20 nondetergent motor oil and put one teaspoon, 5cc, 3/16 oz., or 16 to 25 drops in each oil port.
   d. Allow time for oil to be absorbed by each bearing, then wipe excess oil from motor housing.
   e. Replace dust caps or plugs in oil ports.
3. Remove and clean blower wheel as follows:
   a. Ensure proper reassembly by marking wheel orientation and cutoff plate location.
   b. Remove screws holding cutoff plate, and remove plate from housing.
   c. Lift wheel from housing. When handling and/or cleaning blower wheel, be sure not to disturb balance weights (clips) on blower wheel vanes, and be sure not to drop or bend wheel.
   d. Remove caked-on dirt from wheel and housing with a brush. Remove lint and/or dirt accumulations from wheel and housing with vacuum cleaner, using soft brush attachment. Remove grease and oil with mild solvent.
   e. Reassemble wheel and cutoff plate into housing.
4. Reassemble motor into housing. Be sure setscrew(s) are tightened on motor shaft flats and not on round part of shaft.
5. Reinstall blower assembly into unit and reconnect all blower motor leads to proper termination points in unit control box. Replace panels.
6. Restore electrical power to unit. Start unit and check for proper blower rotation and motor speed.

D. Belt-Drive Indoor Blower and Motor (Size 060, 3-phase unit)

For longer life, operating economy, and continuing efficiency; clean accumulated dirt and grease from the blower wheel and motor annually.

Lubricate the motor every 5 years if the motor is used intermittently (thermostat FAN switch in AUTO position), or every 2 years if the motor is used continuously (theromostat FAN switch in ON position).

NOTE: Motor may have prelubricated bearings and no oil ports. When lubrication is required for this type motor, send the motor to a motor repair shop.

WARNING: Disconnect electrical power to the unit before cleaning and lubricating the blower motor and wheel.

Clean and lubricate the belt-drive blower motor and wheel as follows:

1. Lubricate motor with oil ports as follows:
   a. Thoroughly clean all accumulations of dirt or grease from motor housing.
   b. Remove dust caps or plugs from oil ports located at each end of motor.
   c. Use a good grade of SAE 20 nondetergent motor oil, and put one teaspoon, 5cc, 3/16 oz., or 16 to 25 drops in each oil port.
   d. Allow time for oil to be absorbed by each bearing, then wipe excess oil from motor housing.
   e. Replace dust caps or plugs in oil ports.
2. Remove and clean blower wheel as follows:
   a. Refer to unit wiring label, and disconnect blower motor leads from their termination points in unit control box.
   b. Remove blower assembly from unit. Be careful not to tear insulation in blower compartment.
   c. Relieve belt tension, then remove belt from pulleys.
   d. Ensure proper reassembly by marking wheel orientation and cutoff plate location.
   e. Remove screws holding cutoff plate, and remove plate from housing.
   f. Loosen shaft retainer ring setscrew (located on wheel side of bearing). Loosen two blower wheel setscrews. Note location of all spacer washers and retainer rings for proper reassembly, then remove pulley and shaft from blower assembly.
   g. Lift wheel from housing. When handling and/or cleaning blower wheel, be sure not to disturb balance weights (clips) on blower wheel vanes, and be sure not to drop or bend wheel.
   h. Remove caked-on dirt from wheel and housing with a brush. Remove lint and/or dirt accumulations from wheel and housing with vacuum cleaner, using soft brush attachment. Remove grease and oil with mild solvent. Reassemble wheel, pulley, shaft, and cutoff plate into housing.
   i. Reinstall blower assembly. Replace belt and adjust tension for approximately one inch of sag under normal finger pressure midway between pulleys. Reconnect blower motor leads in control box.

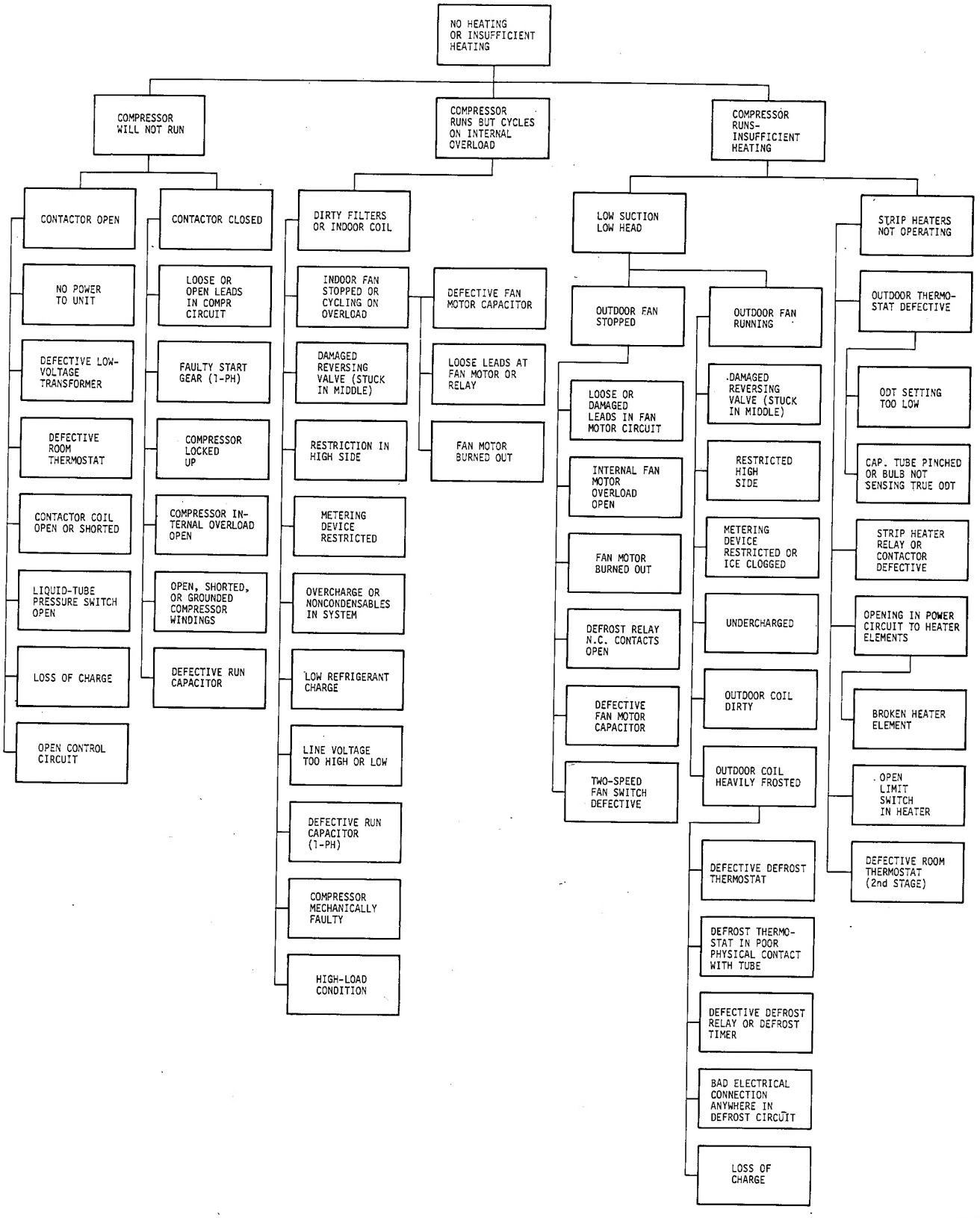
E. Outdoor Coil, Indoor Coil, and Condensate Drain Pan

Inspect the outdoor coil, indoor coil, and condensate drain pan at least once each year. Proper inspection and cleaning requires the removal of the unit top. See part A of this section.

The coils are easily cleaned when dry; therefore, inspect and clean the coils either before or after each cooling season. Remove all obstructions including weeds and shrubs that interfere with the airflow through the condenser coil. Straighten bent fins with a fin comb. If coated with dirt or lint, clean the coils with a vacuum cleaner, using the soft brush attachment. Be careful not to bend the fins. If coated with oil or grease, clean the coils with a mild detergent-and-water solution. Rinse coils with clear water, using a garden hose. Be careful not to splash water on motors, insulation, wiring, or air filter(s). For best results, spray outdoor coil fins from inside to outside the unit. Be sure to clean between the inner and outer coils, and to flush all dirt and debris from the unit base.

Inspect the drain pan and condensate drain line when inspecting the coils. Clean the drain pan and condensate drain by removing all foreign matter from the pan. Flush the pan and drain tube with clear water. Do not splash water

TABLE VIII—TROUBLESHOOTING CHART—HEATING CYCLE



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on the insulation, motor, wiring, or air filter(s). If the drain tube is restricted, clear it with a "plumber's snake" or similar probe device.

F. Outdoor Fan

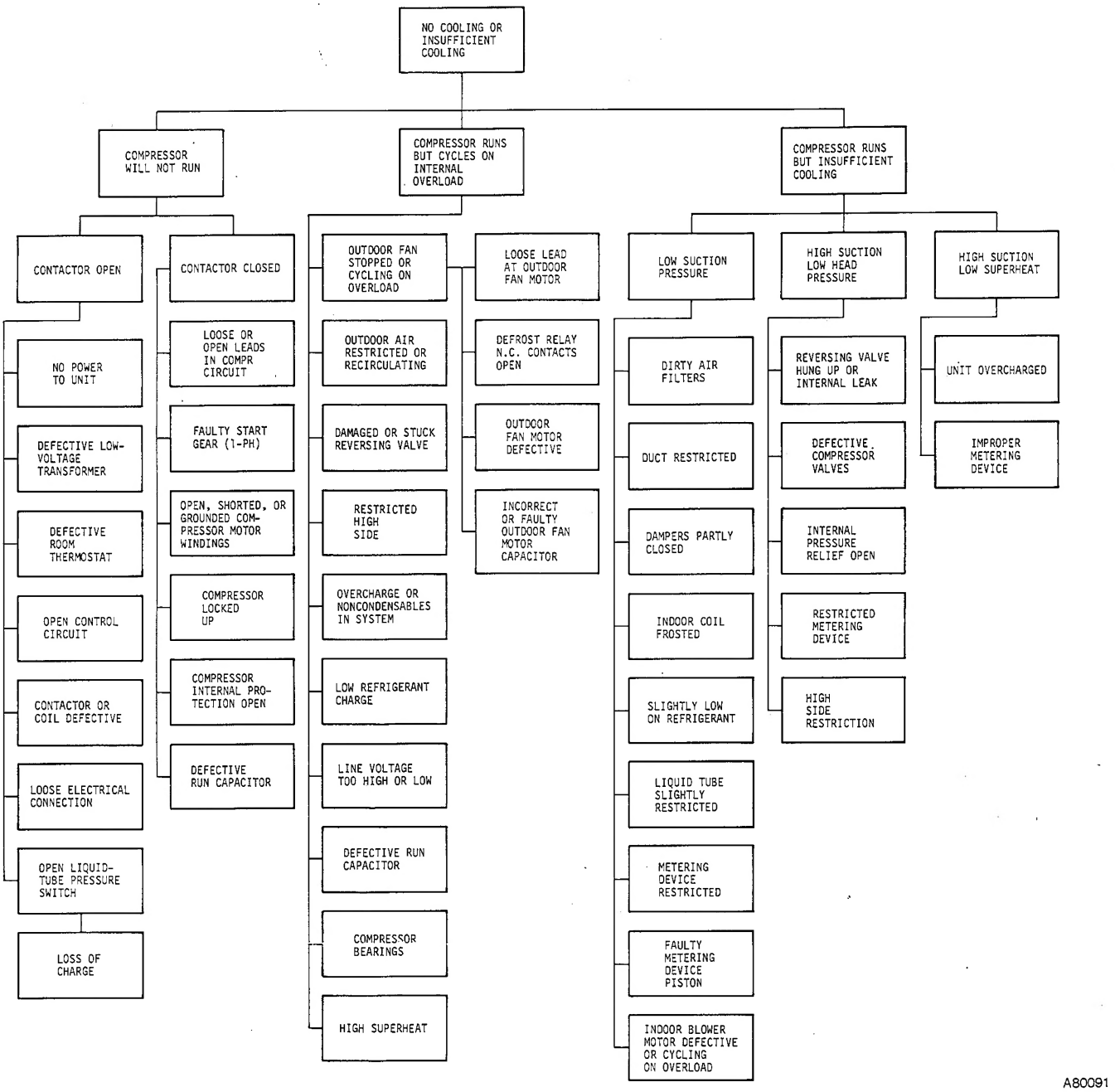
CAUTION: Keep the outdoor fan free from all obstructions to ensure proper operation. Never place articles on top of the unit.

Inspect the fan blades for cracks or bends each year. *Ensure that blades clear the motor by 1/4 inch.* If the blade assembly has slipped down the motor shaft, adjust the fan position on the motor shaft by loosening the setscrew(s) then moving the blade assembly up. Be sure that the setscrew(s) is on the flat(s) of the motor shaft before tightening.

G. Electrical Controls and Wiring

Inspect and check the electrical controls and wiring annu-

TABLE IX—TROUBLESHOOTING CHART—COOLING CYCLE



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ally. *Be sure to disconnect the electrical power to the unit.* Remove the control, blower, and compressor compartment access panels to locate all the electrical controls and wiring. Check all electrical connections for tightness. Tighten all screw connections. If any smoky or burned connections are noticed: disassemble the connection, clean all the parts, restrip the wire end, and reassemble the connection properly and securely.

After inspecting the electrical controls and wiring, replace all the panels. Start the unit, and observe at lease one complete cooling cycle and one complete heating cycle (temperature permitting) to ensure proper operation. If discrepancies are observed or a suspected malfunction has occured, check each electrical component with the proper electrical instrumentation. Refer to the unit wiring label when making these checkouts.

NOTE: Refer to the sequences of operation in this publication as an aid in determining proper control operation.

H. Refrigerant Circuit

Inspect all refrigerant tubing connections and the unit base for oil accumulations annually. Detecting oil genrally indicates a refrigerant leak.

If oil is detected or if diminished performance is suspected, leak-test all refrigerant tubing; using an electronic leak detector, halide torch, or liquid soap solution. If a refrigerant leak is detected, see Section V, part B, "Refrigerant Leaks," in this publication.

If no refrigerant leaks are found and diminished performance is suspected, see Section VI, part B, "Checking and Adjusting Refrigerant Charge," in this publication.

I. Indoor Airflow

The indoor airflow does not require checking unless improper performance is suspected. *If a problem exists, be sure that all supply-and return-air grilles ae open and free from obstructions, and that the air filter(s) is clean.* When necessary, refer to Section VI, part C, of this publication to check the system airflow.